6483237

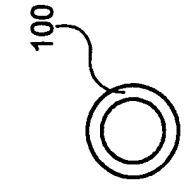

FIG. 1C

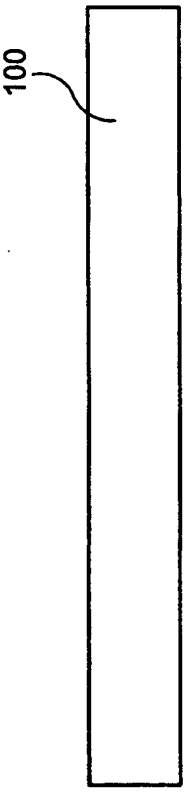

FIG. 1A

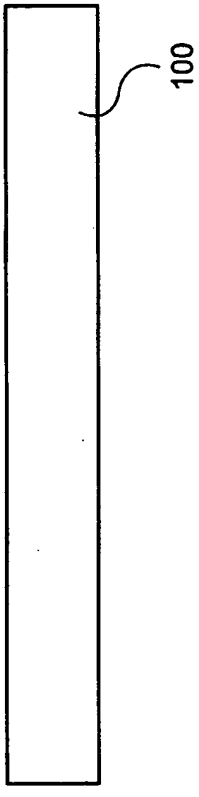

FIG. 1B

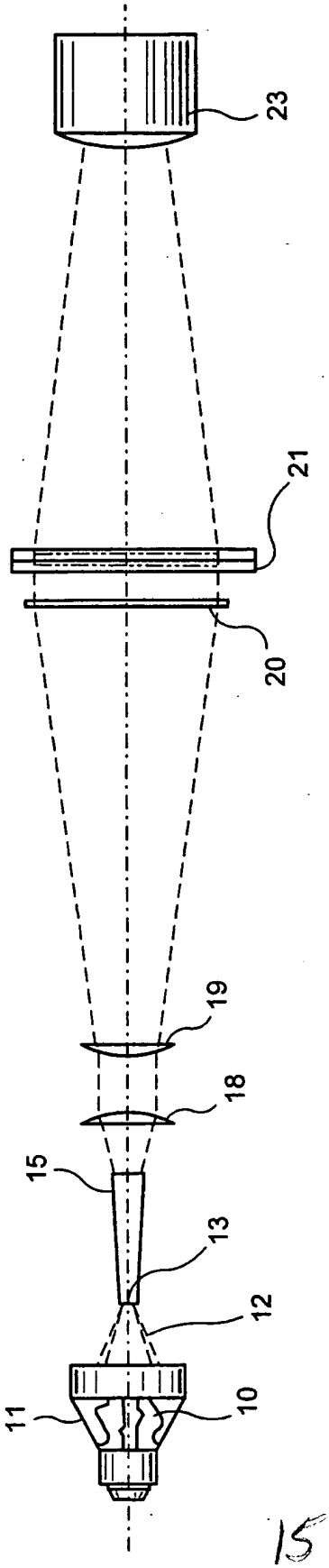

FIG. 2A

15 Figs.

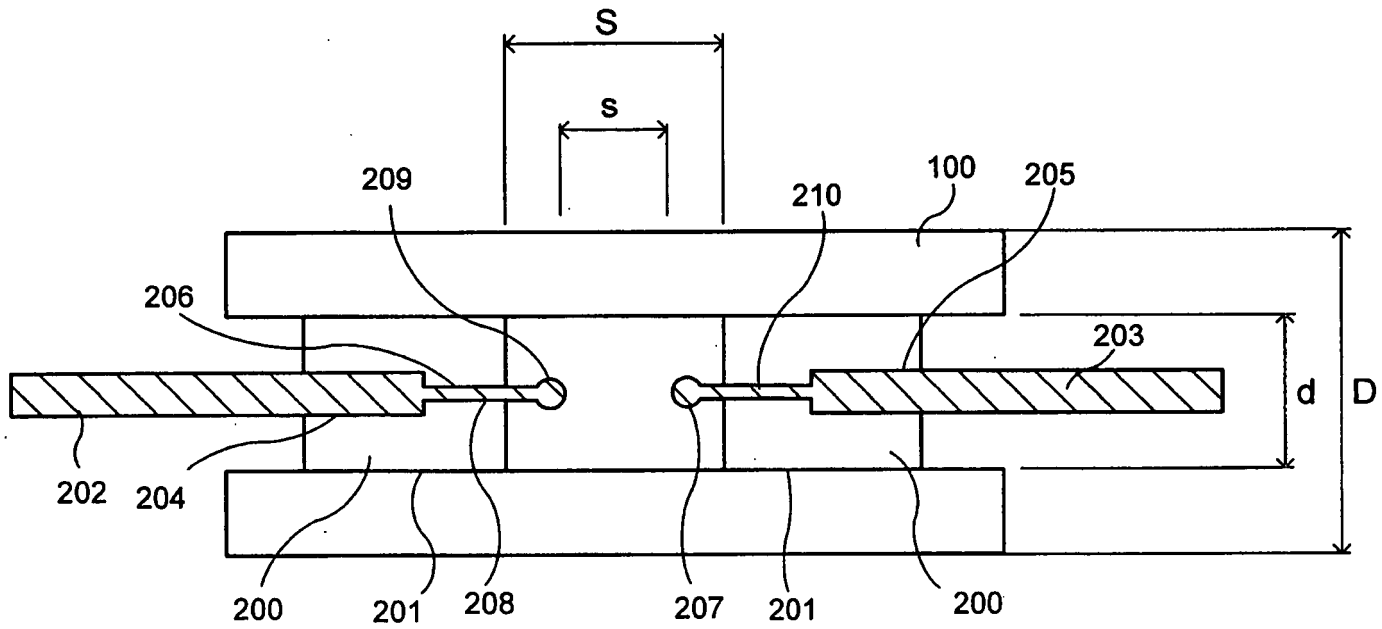

FIG. 2B

$Tinnerwallsapphire_i = deltaT2_i + 273 \cdot K + Touterwall_i$

$Tmaxquartz_i = 1170 \cdot K$

$Tmaxsapphire_i = 1400 \cdot K$

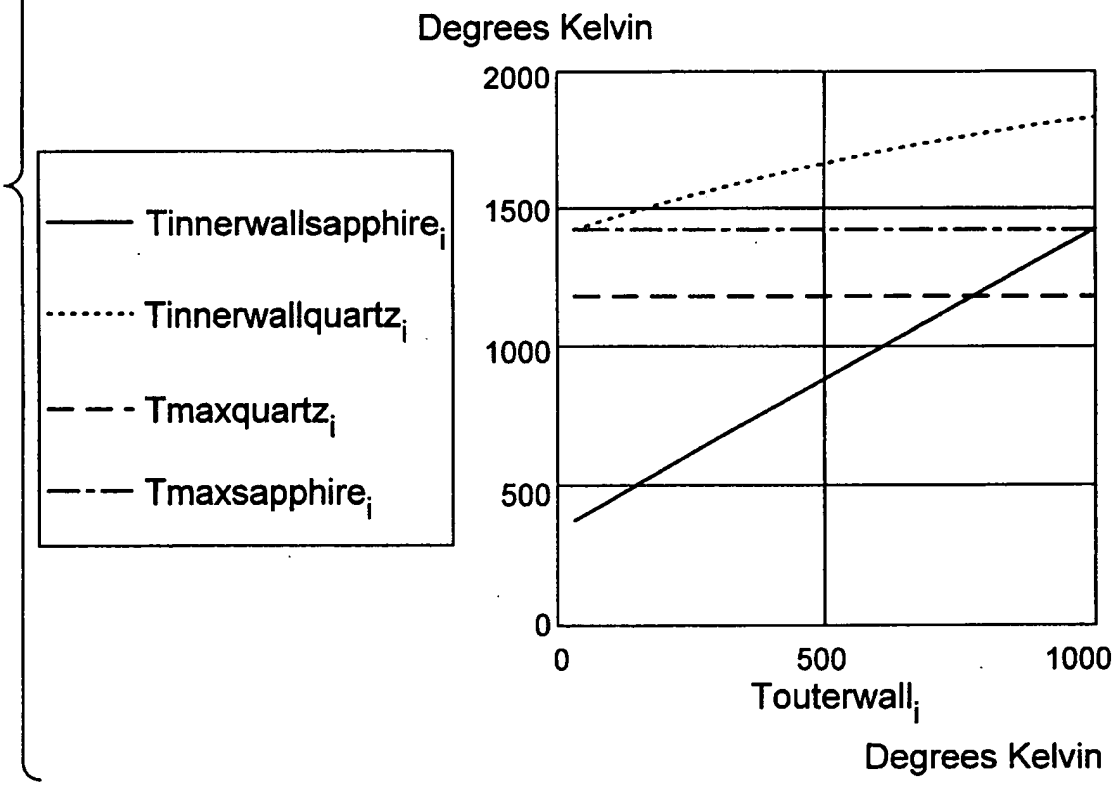

FIG. 3

Total Thermal Plus Hoop Stress on Bulb as a Fraction of Tensile Strength

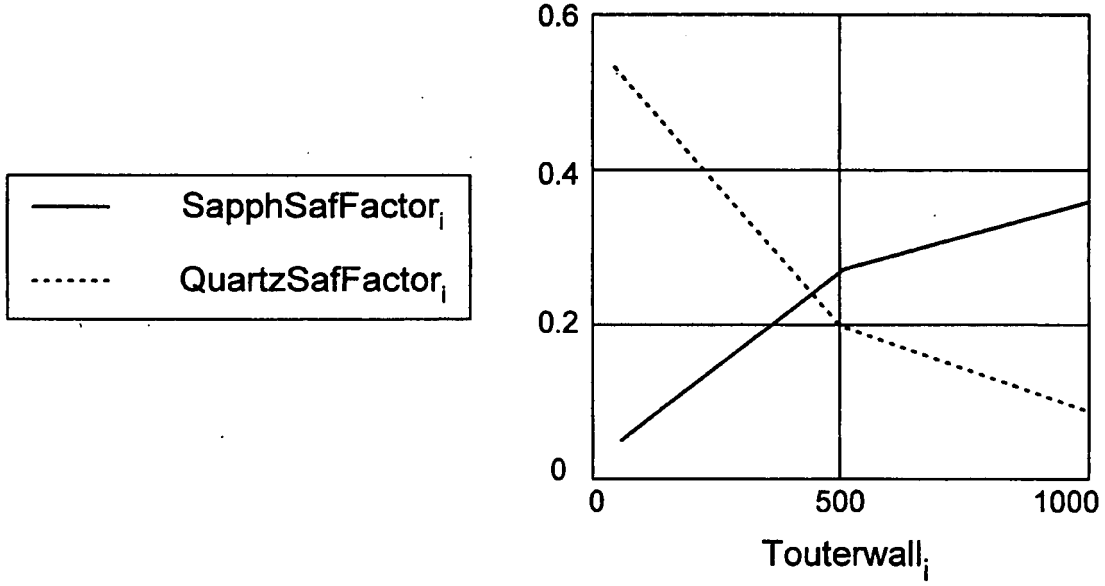

FIG. 4

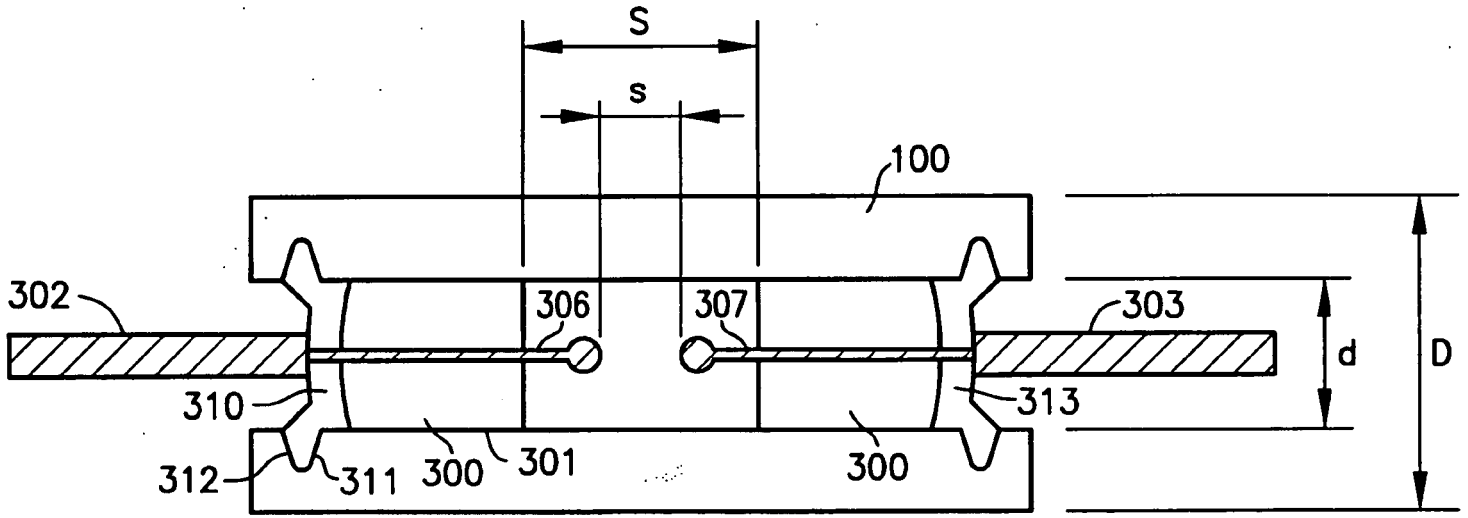

FIG. 5

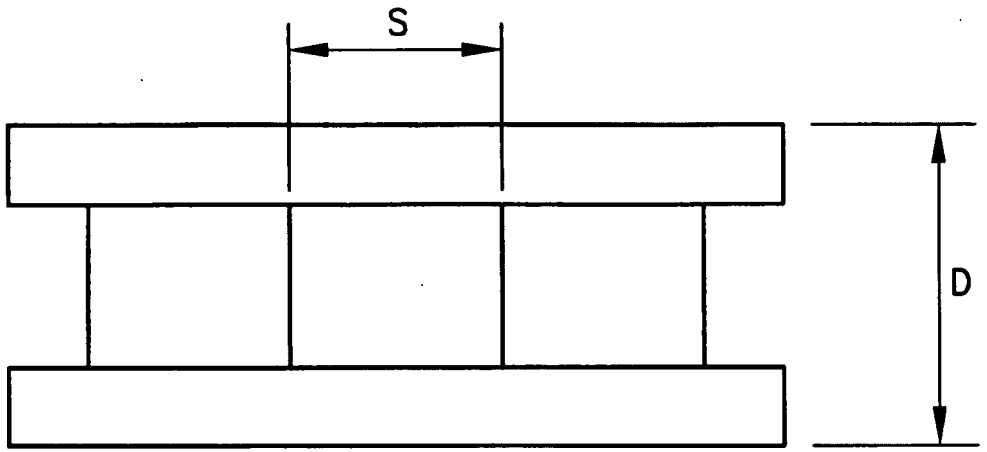

FIG. 6

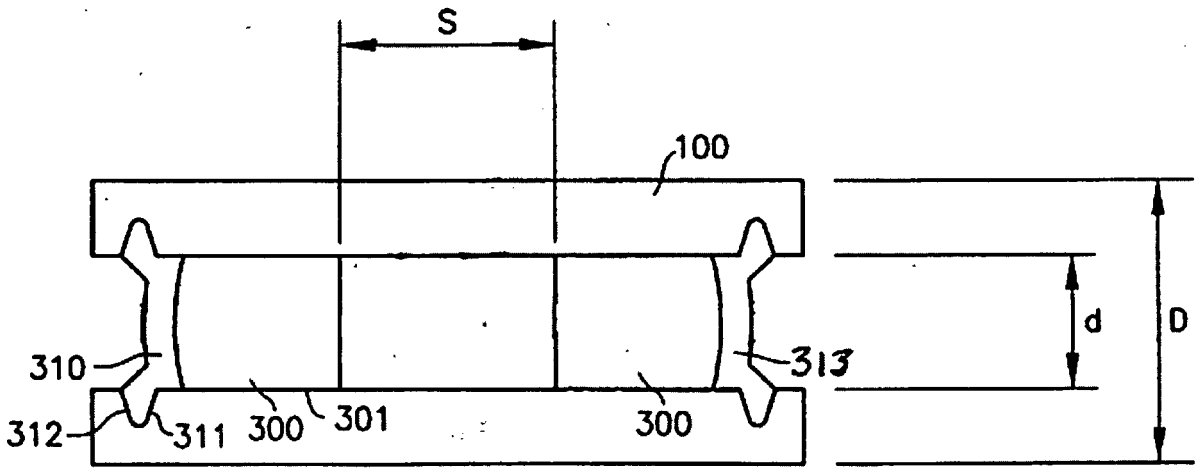

FIG. 7

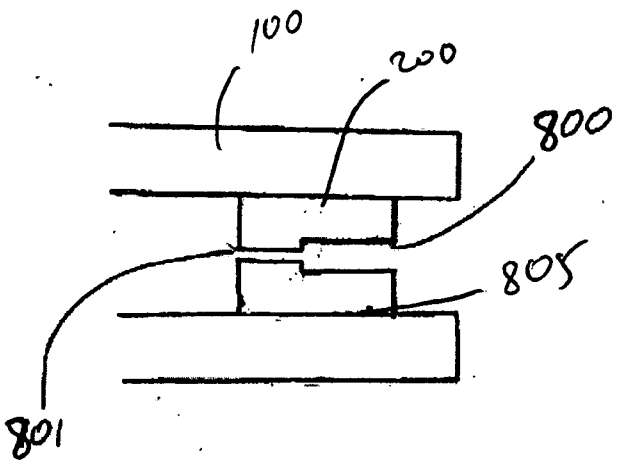

FIG. 8A

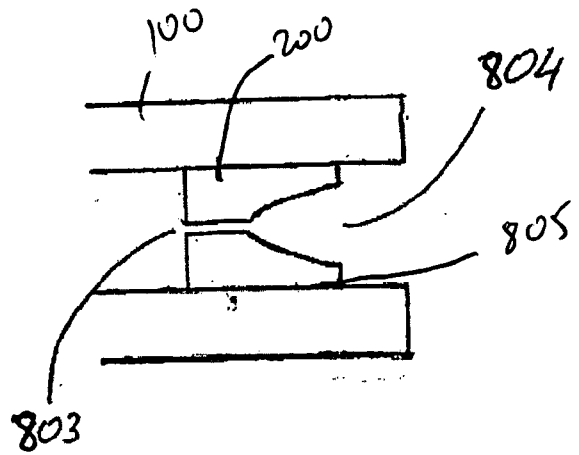

FIG. 8B

SAPPHIRE / QUARTZ COMPARISON

PROPERTIES	Units	Sapphire[1]	Alumina[2]	Quartz[3]
Softening Temperature	°C	2030	2000	1597
Maximum Operating Temperature	°C	1400	1400	900
Thermal Conductivity @ 600°K	W/cm°K	0.189	0.035	0.017
Expansion Coefficient @ 25-1100°C	m/m°K	8.8×10^{-5}	8.3×10^{-6}	4.8×10^{-7}
Tensile Strength @ 25°C [4]	psi	155000	NA	7000
Max Transmittance 0.3-0.9nm (1.0mm wall)	1.0-100%	0.98 (clear)	0.84 (trans-luscent)	0.94 (clear)

[1] Single crystal alumina [2] Poly-crystalline alumina [3] Fused

[4] For tubes: Burst Pressure [2 X Wall Thickness X Tensile Strength @ Temp.] / Tube ID

TABLE 1

Temperature	Tensile Strength Sapphire	Tensile Strength Quartz
25°C	155000 psi	7000 psi
500°C	80000 psi	16500 psi
1000°C	73000 psi	24000 psi
1400°C	56000 psi	FAILURE

FOR TUBES

Burst Pressure - (2 X Wall Thickness X Tensile Strength @ Temp)/ID

TABLE 2

THERMAL CONDUCTIVITY (W/CM • K)

TEMP (°C)	SAPPHIRE	QUARTZ
25	0.46	0.0138
800	0.17	0.018
1000	0.105	0.03

TABLE 3